

Signal

Features in detail

EVOKED RESPONSE - TMS

Signal for Windows incorporates many powerful features for evoked response types of experiments. In conjunction with a CED 1401 data acquisition unit the software is able to deliver digital and analogue control signals to trigger many types of stimulator. Sweeps of data containing the response to these stimuli are marked with stimulus information allowing for analysis of sub sections of an experiment protocol.

Control

Control of many types of external stimulator are available within Signal. These include simple digital triggers for a one off or train of pulses or signalling via an analogue output to devices which 'follow' a waveform pattern such as a constant current stimulator. Further control of units such as the Magstim Rapid etc. is available through a serial line. Support for these devices includes changes of the stimulus intensity and rate.

A user-friendly graphical interface helps define the pulses and displays how they will be played out. A common example is to deliver paired pulses where three different outputs are required. 5, 10 and 15ms intervals separating the trigger pairs are used and each pair is placed in to its own output 'state'. We can now step through the states or choose to sequence randomly or through a defined protocol.

Stimuli can be modified while recording with the changes implemented at the next sweep start. Up to 256 different states of output can be defined and sequenced in a defined protocol or randomly. The pulse trains are stored inside the CED 1401 interface for very precise timing.

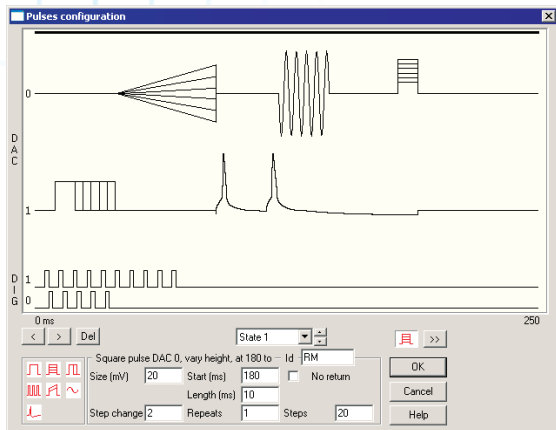
The 1401 interface can also be told to wait for a condition such as the subject achieving a percentage of maximal force before a stimulus trigger is presented.

Advanced control

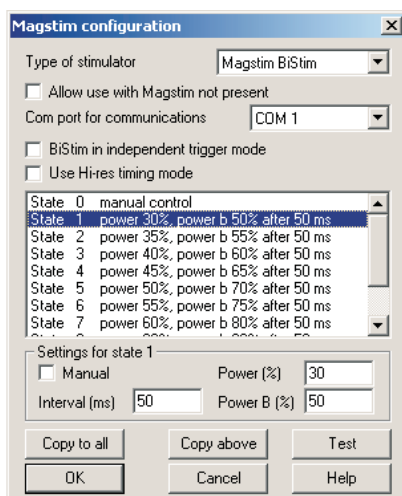
The graphical interface for stimulus generation also includes functions for arbitrary waveform generation, number of repetitions etc. If the graphical sequencer does not produce exactly what you need then there is also a text equivalent which can be programmed with much tighter control of timings and conditions. It also allows for wait for... states, branch on condition and the ability set a percentage chance of a state being delivered for a pseudo random output. A link to the Signal script language enables the user to write their own application and send variables to the sequencer updating such values as amplitudes and times.

Amplifier control

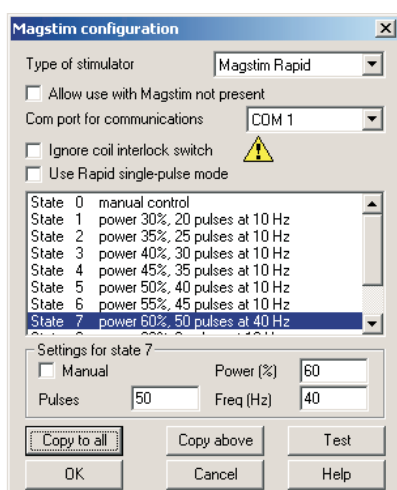
The 1902 isolated pre-amplifier from CED is also software controlled via a serial line. It is designed to work with surface electrodes or with needle electrodes if using a CED active headstage. It includes digital filtering which means you can set your own filter characteristics in terms of cutoff and filter type. An optional stimulus artefact clamp can be fitted which greatly improves the amplifiers recovery time after a high intensity stimulus has been delivered.



Pulse configuration dialog



Magstim BiStim control



Magstim Rapid

Analysis

Signal is ideally suited to the analysis of sweep based data. Averages of responses can be obtained from all sweeps or a subset of states marked according to the stimulus given. Averages can be created with error bars showing standard deviations or standard error of the mean. Single and multiple channel processing is available. Automatic artefact rejection based on amplitude in a defined area prevents overrange data being added to results.

Active cursors update their positions for every frame seeking user defined waveform features. The positions of the cursors are read back to plot XY coordinates into a trend plot. Measurements include areas (inc. RMS amp), times, amplitudes and slope.

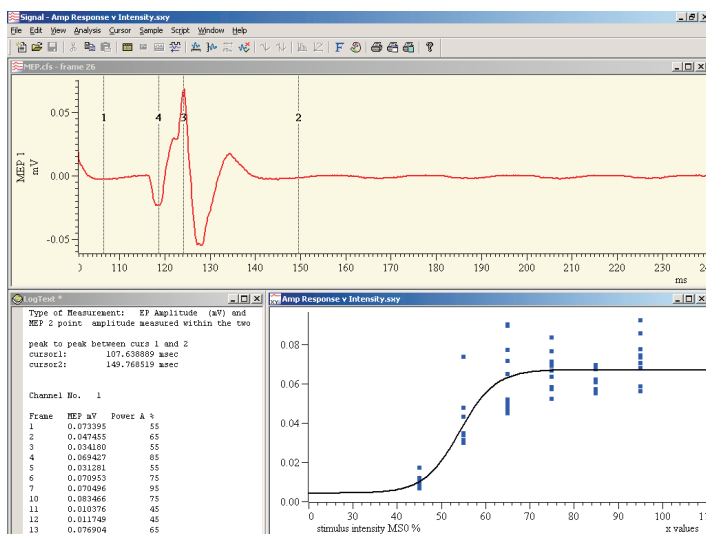
- On and off-line analysis of data
- Automatic control and marking of data
- Feature seeking cursors for plotting response times and amplitudes
- Generate waveform and digital outputs in a drag and drop graphical editor
- Change stimulus protocols on a button press

Advanced analysis

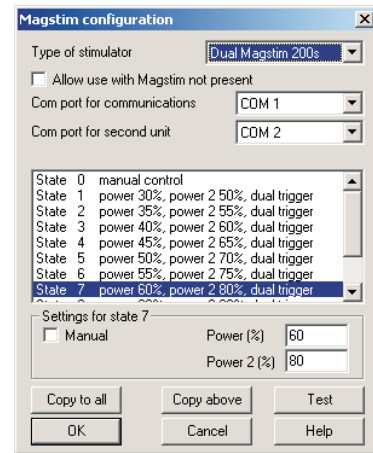
To automate the analyses already built-in to Signal or to define your own custom routines, the program comes complete with a script language. Measurement of the silent period between responses is one example of its use. The script would automatically make a copy of the original channel, apply DC removal to it and then square the data, perhaps also high pass filtering the waveform. The script applies these processes in order and on each of the frames of data within a file saving a lot of time.

Output

Once the data has been captured you may choose to output to a graphics package for publication or for further analysis in spreadsheet or in native Matlab format.



MEP analysis showing amplitude versus intensity



Control panel for Magstim 200 in dual mode



The CED 3304 Current Stimulator



The CED 1902 Isolated pre-amplifier



19" rack-mount multiple 1902s



The Micro 1401 and Power 1401

CED

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